

1 **CLAIMS**

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3 1. A method comprising:

4 identifying an abrupt transition in average light intensity between two

5 frames; and

6 determining whether the abrupt transition was caused by a shot boundary

7 between the two frames or by a flashlight event.

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9 2. A method according to claim 1, wherein identifying an abrupt

10 transition comprises:

11 calculating a difference in light intensity histograms between the current

12 frame and a preceding frame; and

13 comparing the histogram difference to a dynamically determined threshold,

14 wherein an abrupt transition is indicated if the histogram difference exceeds the

15 threshold.

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17 3. A method according to claim 2, wherein dynamically determining the

18 threshold comprises:

19 calculating an average and standard deviation value of the histogram

20 difference in a sliding window of frames;

21 generating one or more thresholds as multiples of the calculated average;

22 and

23 determining whether the calculated standard deviation falls below a

24 standard deviation threshold before adopting the generated one or more thresholds.

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1           4.    A method according to claim 3, wherein generating one or more  
2 thresholds comprises:

3               calculating a high threshold that is four- to five-times the calculated  
4 average; and

5               calculating a low average that is two- to three-times the calculated average.  
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7           5.    A method according to claim 4, wherein the high threshold is used to  
8 determine whether an abrupt transition has occurred.  
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10          6.    A method according to claim 4, wherein the low threshold is used to  
11 indicate whether a gradual transition has occurred, if the histogram difference does  
12 not exceed the high threshold.  
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14          7.    A method according to claim 6, further comprising:  
15               comparing the histogram difference to the low threshold;  
16               accumulating the histogram difference of two or more frames if the  
17 histogram difference exceeds the low threshold; and  
18               determining that a gradual transition has occurred if the accumulated  
19 histogram difference exceeds the high threshold.  
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1           8.    A method according to claim 1, wherein determining a cause of the  
2 abrupt transition comprises:

3               calculating a difference in average minimal intensity values between a  
4 window of frames preceding the current frame and a window of frames subsequent  
5 to the current frame;

6               generating a ratio of the average intensity change of the current frame to the  
7 calculated difference in average minimal intensity values; and

8               concluding that the abrupt transition is caused by a flashlight event if the  
9 ratio does not exceed a threshold.  
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11           9.    A method according to claim 8, wherein calculating a difference in  
12 average minimal intensity values comprises:

13               identifying a window of frames on either side of the current frame;

14               generating an average minimal intensity value for each window from a first  
15 and second minimal intensity value of each frame, respectively; and

16               calculating the difference between the generated average minimal intensity  
17 values.  
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19           10.   A method according to claim 8, wherein the threshold is equal to one  
20 (1), wherein a ratio that deviates from one indicates that the abrupt transition is due  
21 to a shot cut, while a ratio close to one indicates that the abrupt transition is due to  
22 a flashlight event.  
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1           **11.**    A storage medium comprising a plurality of executable instructions  
2 which, when executed, implement a method according to claim 1.  
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4           **12.**    A media analysis agent comprising:  
5           a shot boundary detector to statistically analyze one or more attributes  
6 associated with content in video frames to detect abrupt and gradual transitions in  
7 the video content indicative of a shot boundary; and  
8

9           a flashlight detector, responsive to the shot boundary detector, to distinguish  
10 abrupt transitions in the video content caused by flashlight events from those  
11 caused by actual shot boundaries, to reduce false-positive identification of  
12 flashlight events as shot boundaries.  
13

14           **13.**    A media analysis agent according to claim 12, further comprising:  
15           an adaptive threshold selection module, responsive to the shot boundary  
16 detector, to dynamically set one or more thresholds for use in shot boundary  
17 identification based, at least in part, on one or more attributes of video content.  
18

19           **14.**    A media analysis agent according to claim 13, wherein the adaptive  
20 threshold selection module calculates an average and standard deviation of a  
21 histogram difference in a sliding window of frames surrounding the current frame,  
22 and generates a proposed low threshold value ( $T_s$ ) and a proposed high-threshold  
23 value ( $T_b$ ) from the average histogram difference.  
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1           15.    A media analysis agent according to claim 14, wherein the proposed  
2 low threshold is two- to three-times the calculated average histogram difference,  
3 while the proposed high threshold is four- to five-times the calculated average  
4 histogram difference.

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6           16.    A media analysis agent according to claim 14, wherein the adaptive  
7 threshold selection module certifies the proposed thresholds if the calculated  
8 standard deviation does not reach a standard deviation threshold.

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10          17.    A media analysis agent according to claim 16, wherein if the  
11 adaptive threshold selection module cannot certify the proposed thresholds, prior  
12 thresholds are used by shot boundary detector.

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14          18.    A media analysis agent according to claim 14, wherein the high  
15 threshold is used to identify an abrupt transition, while the low threshold is used to  
16 indicate a potential gradual transition.

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18          19.    A media analysis agent according to claim 18, wherein shot  
19 boundary detector compares the histogram difference to a low threshold if the  
20 difference does not exceed the high threshold, and accumulates the histogram  
21 differences of frames wherein the difference exceeds the low threshold.  
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1           **20.**   A media analysis agent according to claim 19, wherein shot  
2 boundary detector identifies a gradual transition when the accumulated histogram  
3 differences exceed the high threshold.  
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5           **21.**   A media analysis agent according to claim 13, wherein the shot  
6 boundary detector calculates a difference in light intensity histograms between a  
7 current frame and a preceding frame, and compares the histogram difference to a  
8 dynamically determined threshold, wherein an abrupt transition is identified by a  
9 histogram difference that exceeds the threshold.  
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11           **22.**   A media analysis agent according to claim 21, wherein shot  
12 boundary detector invokes an instance of flashlight detector to determine whether  
13 the abrupt transition is the result of a flashlight event.  
14

15           **23.**   A media analysis agent according to claim 12, wherein flashlight  
16 detector calculates a difference in average minimal intensity values between a first  
17 sliding window preceding the current frame, and a second sliding window  
18 subsequent to the current frame.  
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20           **24.**   A media analysis agent according to claim 23, wherein flashlight  
21 detector calculates the average intensity change of the current frame, and generates  
22 a ratio of the difference in average minimal intensity values to the average  
23 intensity change of the current frame.  
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1           **25.**    A media analysis agent according to claim 24, wherein flashlight  
2 detector determines that the abrupt change was due to a flashlight event if the ratio  
3 does not exceed a threshold value.  
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5           **26.**    A media analysis agent according to claim 25, wherein the threshold  
6 value is one (1).  
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8           **27.**    A media analysis agent according to claim 25, wherein the flashlight  
9 detector concludes that the abrupt transition was caused by a shot boundary if the  
10 ratio exceeds the threshold value.  
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12           **28.**    A computing system comprising:  
13           a memory, to receive media content; and  
14           a media processing system, coupled to the memory device, including a  
15 media analysis agent according to claim 12 to segment the received media content  
16 into uniquely identifiable shots.  
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18           **29.**    A storage medium comprising a plurality of executable instructions  
19 which, when executed, implement a media analysis agent to detect shot boundaries  
20 resulting from an abrupt or gradual transition in content between frames, and  
21 further to distinguish abrupt transitions caused by shot cuts from those caused by  
22 flashlight events.  
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1           **30.**   A storage medium according to claim 29, wherein the media analysis  
2 agent calculates a difference in average minimal intensity values between a first  
3 sliding window preceding the current frame, and a second sliding window  
4 subsequent to the current frame, and calculates the average intensity change of the  
5 current frame, and generates a ratio of the difference in average minimal intensity  
6 values to the average intensity change of the current frame.

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8           **31.**   A storage medium according to claim 30, wherein media analysis  
9 agent determines that the abrupt change was due to a flashlight event if the ratio  
10 does not exceed a threshold value.

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12           **32.**   A storage medium according to claim 31, wherein the threshold  
13 value is one (1).

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15           **33.**   One or more computer-readable media having stored thereon a  
16 computer program that, when executed by one or more processors, causes the one  
17 or more processors to:

18           calculate a difference in light intensity histograms between two frames;  
19           compare the histogram difference to a dynamically determined threshold,  
20 wherein an abrupt transition is indicated if the histogram difference exceeds the  
21 threshold; and

22           determine whether the abrupt transition was caused by a shot boundary  
23 between the two frames or by a flashlight event.  
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1           **34.**   One or more computer-readable media as recited in claim 33  
2 wherein to determine the dynamic threshold, the one or more processors:

3           calculate an average and standard deviation value of the histogram  
4 difference in a sliding window of frames;

5           generate one or more thresholds as multiples of the calculated average; and

6           determine whether the calculated standard deviation falls below a standard  
7 deviation threshold before adopting the generated one or more thresholds.  
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9           **35.**   One or more computer-readable media as recited in claim 33  
10 wherein to determine a cause of the abrupt transition, the one or more processors:

11           calculate a difference in average minimal intensity values between a  
12 window of frames preceding the current frame and a window of frames subsequent  
13 to the current frame;

14           generate a ratio of the average intensity change of the current frame to the  
15 calculated difference in average minimal intensity values; and

16           conclude that the abrupt transition is caused by a flashlight event if the ratio  
17 does not exceed a threshold.  
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19           **36.**   One or more computer-readable media as recited in claim 35  
20 wherein the threshold is equal to one, wherein a ration that deviates from one  
21 indicates that the abrupt transition is due to a shot cut, while a ratio close to one  
22 indicates that the abrupt transition is due to a flashlight event.  
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